Fertilizers IN ALBERTA

SOIL FEEDS PLANTS

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PLANTS FEED ANIMALS

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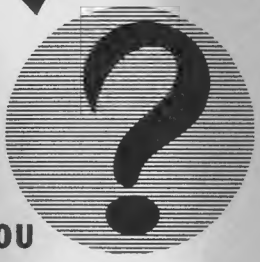
ANIMALS AND PLANTS FEED YOU



BUT

WHO FEEDS THE SOIL?

PROVINCE OF ALBERTA
DEPARTMENT of AGRICULTURE

HON. L. C. HALMRAST
MINISTER

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This circular has been prepared by the Provincial Advisory Fertilizer Committee, appointed by Honorable L. C. Halmrast, Minister of Agriculture.

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FOREWORD

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OUR soil is the foundation of our prosperity, progress and happiness. Deeply rooted in the soil is our independence, our safety and our welfare. We should maintain our soil in a highly productive state as an expression of good intentions towards nature and to our fellow men, including those not yet born.

Constant cropping without good fertility management exhausts the land. Plants take from the soil certain elements which they use as raw materials to build plant foods. When crops are sold off the farm, either directly or through live stock, fertility in the form of minerals obtained from the soil is removed. Fertility is also removed by soil erosion and leaching. To replace this fertility we must :

(1) Practise good cultural methods.

(2) Adopt a good cropping system, including legumes and grasses wherever possible.

(3) Make the best use of farm manure.

(4) Use suitable commercial fertilizers where recommended.

FERTILIZERS AND PLANT NUTRIENTS

PLANT nutrients are chemical elements which crops must obtain from the soil in adequate amounts if they are to grow satisfactorily. A fertilizer supplies one or more plant nutrient elements, of which nitrogen, phosphorus, potassium and sulphur are examples. Farm manure, green manures, legumes and commercial fertilizers are all used to supply one or more of these elements in order to improve crop yields.

Of the chemical elements which plants must obtain from the soil there are four which are most likely to be deficient in Alberta soils. These four elements are nitrogen, phosphorus, potassium, and sulphur. Each has specific essential roles in plant nutrition.

What nitrogen does:

- Gives dark green color to plants.
- Produces rapid growth.
- Feeds soil micro-organisms during their decomposition of low-nitrogen organic materials.
- May increase yields of leaf, fruit, or seed.
- May improve quality of leaf crops.
- May increase protein content of food and feed crops.

What phosphorus does:

- Stimulates early root formation and growth.
- Gives rapid and vigorous start to plants.
- Gives winter hardiness to fall-seeded grains and hay crops.
- Often hastens maturity.
- May stimulate blooming and aid in seed formation.

What potassium does:

- Imparts increased vigor and disease resistance to plants.
- Produces strong, stiff stalks, thus may reduce lodging.
- Increases plumpness of the grain and seed.
- Essential to the formation and transfer of starches, sugars, and oils.
- Imparts winter hardiness to legumes and other crops.

What sulphur does:

- Gives increased root growth.
- Helps maintain dark green color.
- Promotes nodule formation on legumes.
- Encourages more vigorous plant growth.
- May stimulate seed production.
- Often increases protein content of alfalfa and clovers by 1/10 to 1/4.

Calcium and magnesium and the six so-called trace elements all have their own specific roles in plant nutrition. However, tests to date have not yet found a general deficiency of any of these elements anywhere in Alberta.

Alberta soils in general appear to contain sufficient potassium. Responses to potassium have occurred only in isolated cases, mainly in peat fields.

NOTE : — Some common names are widely used when referring to compounds containing the chemical elements supplied by fertilizers. Examples follow :

Pure chemical element	Some common names applied to compounds containing element
Nitrogen	ammonia; nitrate
Phosphorus	phosphate; phosphoric acid; phosphorus pentoxide
Potassium	potash
Sulphur	sulphate

Manuring is a good practice.

FARM MANURE

Farm manure is one of the best fertilizers. It supplies not only plant nutrients, but it adds organic matter to the soil. This organic matter improves the physical condition of the land and helps it to hold moisture and resist erosion. Manure is rather low in phosphate, so phosphate fertilizers generally should be used on manured land for best results.

On most Alberta farms there is not enough manure to supply all the fertilizer needed, but even a limited supply can be used to advantage. Spread over as large an area as practical, manure will give greater immediate returns per ton than if spread heavily. Usually it is better to utilize 30 tons on three acres than on one acre.

Sweet clover provides good growth for green manure.

GREEN MANURES

Green manuring is another way to improve the soil Immature cereal or legume crops worked into the land add organic matter, improve the physical condition of the soil, and often increase the supply of available plant nutrients.

Green manures do not add any mineral which they have not previously taken from the soil, but the supply of nitrogen may be increased by ploughing under properly inoculated legumes. Inoculation introduces bacteria which, in association with the legume roots, change nitrogen of the air into compounds useful to both the bacteria and the legume. Cereal crops that follow also benefit from this increase of nitrogen in the soil.

Green manuring in Alberta should be limited to the following cases :

(1) On irrigated land, preferably using a legume.

(2) On grey wooded soils using a legume or a legume-grass mixture.

(3) Grain farmers often obtain beneficial results by seeding sweet clover with a grain crop using the sweet clover as a green manure in what would otherwise be a fallow year.

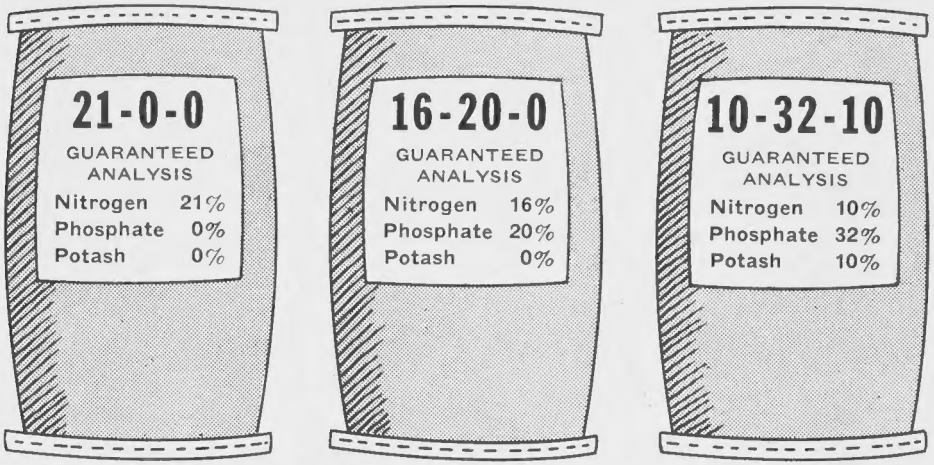
(4) In other areas of Alberta green manuring should generally be limited to legume and grass stands being broken up from hay or pasture.

On irrigated land and grey wooded soils the best results frequently are obtained by green manuring the entire legume crop. In other areas satisfactory results are obtained by allowing some regrowth after haying or pasturing. If the legume is plowed immediately after haying the benefit to subsequent cereal crops may not be so great. It is better to cut the hay early and if moisture conditions are favorable let the legume make some regrowth before plowing down.

A high analysis phosphorus fertilizer usually gives excellent returns on land that has been green manured with a legume.

COMMERCIAL FERTILIZERS

Commercial fertilizers are manufactured products which contain one or more plant nutrient elements. They supply in concentraied form the same nutrients which plants obtain from the soil. Used in accordance with recommendations in this bulletin commercial fertilizers cannot injure the soil or crops in any way. A guaranteed analysis of the nitrogen, phosphorus and potassium content must be clearly indicated on the fertilizer bag or container. This ruling, provided under the Canadian Fertilizer Act, is for your protection and guidance.



WHAT'S IN THE BAG?

When buying a commercial fertilizer study the figures on the container and be guided by them. They may save you money. They show the percentage of nitrogen, phosphate and potash — and always in that order. For example, a fertilizer labelled 10-32-10 contains 10% nitrogen (N), 32% phosphate (P_2O_5) and 10% potash (K_2O). These figures show the major plant nutrients that you are getting, and with their help you can choose the fertilizer that will supply most economically the plant nutrient or nutrients you need. Most fertilizers also contain small quantities of some other plant nutrient elements which may be beneficial to plant growth, but these are not shown on the container. Sulphur is such an element, and some of our soils in Alberta need this plant nutrient.

From the cost of fertilizers the cost per pound for each of the various nutrients may be calculated as follows:

For nitrogen (N): If 1 ton of ammonium nitrate costs $81.00 and contains 670 lbs. of nitrogen, the cost per pound of nitrogen in this fertilizer is approximately 12c.

For phosphate (P_2O_5): If 1 ton of 11-48-0 costs $107.00 and contains 960 lbs. of phosphate, the cost per pound of phosphate here is approximately 11c. (This calculation disregards the 220 pounds of nitrogen in a ton of 11-48-0. At 12c per pound; 220 pounds of nitrogen are worth $26.40.)

For potash (K_2O): One ton of 0-0-60 costs $81.00 and contains 1,200 pounds of potash. Therefore the cost per pound of potash here is 6.8 cents.

In Table 1, below, you will find the guaranteed analysis and the sulphur content of some of the fertilizers sold in Alberta.

TABLE 1

Information on Some Fertilizers Available in Alberta. 1956.

Name of Fertilizer	Guaranteed Analysis			Sulphur content %	Guaranteed plant nutrients per ton.		
	N% (Nitrogen)	P_2O_5% (Phosphate)	K_2O% (Potash)		N lb. (Nitrogen)	P_2O_5 lb. (Phosphate)	K_2O lb. (Potash)
Anhydrous ammonia	82	0	0	0	1640	—	—
Ammonium nitrate	33.5	0	0	0	670	—	—
Ammonium sulphate	21	0	0	25	420	—	—
Ammonium nitrate phosphate	27	14	0	low	560	280	—
Ammonium phosphate	16	20	0	14	320	400	—
Ammonium phosphate	11	48	0	low	220	960	—
Complete	10	32	10	5	200	640	200
Farm manure	0.5 (*)	0.25 (*)	0.5 (*)	low	10 (*)	5 (*)	10 (*)
Liquid fertilizer	7	14	7	low	140	280	140
Potassium chloride (nutriate of potash)	0	0	60	low	—	—	1200
Potassium sulphate (sulphate of potash)	0	0	51	20	—	—	1020
Gypsum (calcium sulphate)	—	—	—	18	—	—	—
Sodium sulphate (dry)	—	—	—	22	—	—	—
Sulphur (commercial)	—	—	—	98	—	—	—

* Plant nutrients in manure vary with the kind and age of the manure.

ANHYDROUS AMMONIA

As a fertilizer for direct application to the soil, anhydrous ammonia is new to Alberta farmers. It is the basic material from which other nitrogen fertilizers are made and contains 82% nitrogen. This fertilizer is now used widely by farmers in the United States in areas where nitrogen is needed. It is produced in Alberta.

At normal temperatures and atmospheric pressure, ammonia is a colorless gas that has a sharp penetrating odor. Under sufficient pressure anhydrous ammonia is a liquid. Tanks to hold the liquid should have a working pressure of 250 pounds per square inch, be equiped with suitable steel fittings and a safety valve.

When released in the soil anhydrous ammonia becomes a gas. Therefore it is injected into the soil at depths of four to seven inches to avoid loss of the gas to the air. Ammonia gas attaches to soil particles until taken up by growing plants or until it is converted into soluble nitrate by soil bacteria.

Anhydrous ammonia cannot be applied with the seed at seeding time as is commonly done with the dry fertilizers used in Alberta. Anhydrous ammonia application requires a separate operation but this may be combined with soil tillage. These applications are made with a heavy duty cultivator equipped with an ammonia tank, and a pump or metering device to regulate the flow of ammonia. High pressure hose or pipe conducts the liquid ammonia to a manifold and then down the backs of the cultivator standards to outlets near the bottom of the shanks. Farmers wishing to try anhydrous ammonia will be able to rent this equipment from dealers supplying the ammonia.

Anhydrous ammonia is stored and handled under pressure. The gas itself can be dangerous. Therefore it is essential that those working with ammonia know how to use and handle it safely. Operators should wear tight fitting goggles and rubber gloves when making adjustments to any parts of the equipment that are under pressure.

Comparisons between anhydrous and other nitrogen fertilizers have found no general differences in their effectiveness when applied at rates supplying equal poundages of nitrogen.

LIQUID FERTILIZERS AND FORTIFIED DUSTS

Tests to date indicate that liquid fertilizers available in Alberta as seed treatments are not effective or economical forms of fertilizers for grains. Liquid fertilizers applied with 2,4-D and other herbicides have not been proven to be profitable for Alberta crops.

Foliar application of fortified dusts, leaf-feeding dust fertilizers or liquid fertilizers are not recommended at present, but experimental work with them is being continued.

SOIL AMENDMENTS

Soil amendments provide another type of soil improver. They may or may not act as fertilizers. Lime and peat are examples of these materials.

Lime may be used as a soil amendment to correct an acid condition of the soil. As a fertilizer it may serve to supply calcium. **Very few, if any,**

Alberta soils need lime. If you suspect that your soil is acid, send a sample to the Agricultural Soil and Feed Testing Laboratory, University of Alberta, Edmonton, Alberta. A simple test will show whether or not lime is needed.

Peat may be used to improve the physical condition and moisture-holding capacity of grey soils and clay soils. When properly worked into the soil, well decomposed peat has proven better for this purpose than coarse light-coloured peat. Peatlands are found frequently in the grey wooded soil zones, but because of the labour involved application usually is confined to gardens, greenhouses and other small areas.

Farm manure is one of the best soil conditioners available. Because of its value as a fertilizer, it serves two purposes at the same time.

Chemical soil conditioners are now available. As yet the cost is too great to make their use practical on a large scale. Greenhouse operators and home gardeners may find these chemical soil conditioners useful.

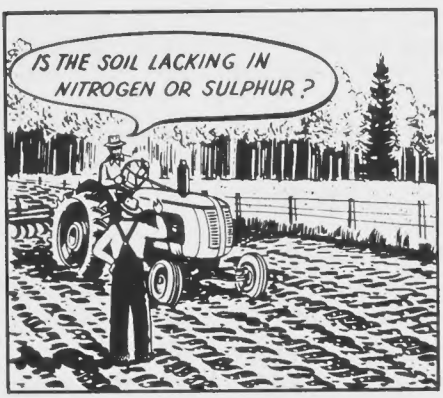
WHAT DOES MY SOIL NEED?

The needs of a soil depend on a number of things. Soils differ greatly from soil zone to soil zone and even within a zone. Therefore your farm location and the kind of crops you grow will help to determine the fertilizer needs of your particular soil.

By referring to the soil zone map of Alberta on page 27 you will be able to determine the zone in which your farm is located.

GREY SOILS AND DEGRADED BLACK (TRANSITION) SOILS

On the grey soils and degraded black (transition) soils nitrogen, phosphorus and sometimes sulphur are the chief fertilizer requirements for grains and grasses. For legumes grown on grey wooded soil, sulphur is of first importance except in the Peace River region of Alberta and British Columbia.



On sulphur-deficient soils legumes are greatly benefited by fertilizers supplying sulphur. The sulphur content of various fertilizers is given in Table 1. Fertilizers supplying only sulphur do not help cereals or grasses much, but when cereals or grasses follow sulphur-fertilized legumes, the benefits are large. The data in Table 2, page 13, show that on severely-leached sulphur-deficient soils, use of suitable fertilizers in conjunction with a crop rotation containing legumes may increase grain yields more than 100 per cent.

TABLE 2

Effects of Fertilizers and Crop Rotation on Yields From a Grey-Wooded Soil at Breton
(University of Alberta, Soils Dept. Plots)

Average Yield Per Acre, 1930 - 1953

Treatment and approximate rate per acre	Fallow grain system—wheat — fallow (one crop in 2 years)	Five-Year Rotation System (Wheat—Oats—Barley—Hay—Hay) A Crop Every Year				
	Yield of Wheat, bus.	Wheat, bus. (Year 1)	Oats, bus. (Year 2)	Barley, bus. (Year 3)	Legume hay, tons (Year 4)	Legume hay, tons (Year 5)
		Yields from Unfertilized Treatments				
No fertilizer	17.6	14.7	27.7	13.5	0.5	0.3
	Yields and Increases for Fertilizer Treatments					
	Yield. Increase.	Yield. Increase.	Yield. Increase.	Yield. Increase.	Yield. Increase.	Yield. Increase
Manure*	29.8 12.2	30.8 16.1	49.6 21.9	25.4 11.9	1.3 0.8	1.2 .9
16-20-0 Plus Pot. Sulph. at approx. 75 lbs.	26.9 9.3	37.9 23.2	54.0 26.3	27.0 13.5	2.5 2.0	2.3 2.0
Ammonium Sulphate at approx. 75 lbs.	24.5 6.9	32.6 17.9	52.9 25.2	26.3 12.8.	2.2 1.7	2.1 1.8
Manure* plus 16-20-0 at approx. 75 lbs.	30.0 12.4	33.2 18.4	54.3 26.6	32.0 18.5	2.3 1.8	2.4 2.1
16-20-0 at approx. 75 lbs.	24.8 7.2	28.2 13.5	49.8 22.1	25.7 12.2	2 3 1 8	2.2 1.9

* Manure at 20 tons per acre once in five years.

For grains, grasses or mixtures of grasses and legumes on grey soils, except those in the Peace River region, fertilizers such as ammonium phosphate (16-20-0) have proven best. These fertilizers contain nitrogen and phosphorus as well as sulphur. For clovers, alfalfa, and other legumes properly inoculated with nitrogen-fixing bacteria, ammonium sulphate, ammonium phosphate (16-20-0), gypsum, sodium sulphate or flowers of sulphur may be expected to give good results because of their sulphur content.

Suggested rates of fertilizer application for various crops on the grey soils and grey transition soils will be found in Table 9, page 23.

GREY SOILS IN THE PEACE RIVER REGION

For grains in the Peace River region ammonium phosphate (11-48-0) usually has been the most profitable fertilizer. In recent years ammonium phosphate 16-20-0 also has given excellent results. Where crops are to be seeded into heavy combine stubble, ammonium phosphate 16-20-0 or other high nitrogen fertilizers are recommended because of their higher nitrogen content. Grasses have responded to nitrogen in the form of ammonium nitrate (33.5-0-0), ammonium sulphate (21-0-0), and ammonium phosphate (16-20-0), the higher percentage nitrogen fertilizers giving the more economical returns. As yet there are no data for tests in this region with anhydrous ammonia. Legumes have shown no response to sulphur, phosphate or other fertilizer elements in the Peace River area. Some data from fertilizer tests in the Peace River region are given in Table 3.

TABLE 3

Average Increase in Yields of Wheat, Oats and Barley on Fallow and Stubble. Peace River Section, 1951 - 1955.

Soil Zone	Crop	Land preparation	No. of tests	Bushels of increase per acre.			
				11-48-0 in pounds/A.		16-20-0 in pounds/A.	
				25	50	60	120
Degraded black and black	Wheat	Fallow	26	8.0	11.6	7.0	9.7
"	"	Stubble	19	5.1	5.9	5.3	7.0
"	Oats	Fallow	13	19.7	23.8	17.5	23.3
"	"	Stubble	13	8.9	11.4	12.7	19.0
"	Barley	Fallow	16	13.6	16.6	13.1	17.9
"	"	Stubble	17	7.5	9.3	10.6	15.2
Grey-wooded	Wheat	Fallow	22	4.2	7.3	5.9	8.8
"	"	Stubble	16	2.7	5.4	4.8	7.4
"	Oats	Fallow	15	11.9	12.6	11.0	19.4
"	"	Stubble	15	9.0	12.7	12.4	19.1
"	Barley	Fallow	16	11.4	15.9	10.3	17.5
"	"	Stubble	15	3.4	7.7	7.3	12.6

PEAT SOILS

Peat soils are common in the grey soil zone. Their variability makes it difficult to formulate a fertilizer recommendation. In many cases, however, nitrogen, phosphorus, and potassium are all needed, and so a complete fertilizer gives best results.

Two suggestions are offered for farmers wishing to try fertilizer on peat soils :

1. Compare a nitrogen and phosphorus supplying fertilizer such as ammonium phosphate 16-20-0 with a complete fertilizer such as 10-32-10 on adjacent parts of the peaty area.
2. Use relatively heavy rates of application (75 to 150 lbs. per acre is suggested).

DARK BROWN AND BLACK SOILS

The prairie and parkland soils of the dark brown and black soil zones usually are short of phosphorus. They normally contain ample sulphur and varying supplies of nitrogen. On these soils fertilizers supplying phosphorus fill the primary need. The results of fertilizer tests on black and dark brown soils (Table 4) show increases obtained from the use of varying amounts of ammonium phosphate (11-48-0). These trials were conducted on the land of co-operating farmers, using ordinary farm equipment and normal seeding methods.

Many tests with nitrogen supplying fertilizers have been placed on stubble land in recent years. Results have been exceedingly variable. (See the section "Fertilizers For Stubble Crops and Straw Decomposition").

Recommended rates of fertilizer application may be found in Table 9, page 23.

TABLE 4

Average Wheat Yield Increases on Summerfallow in Alberta, 1941-1955

Soil Zone	No. of Tests	Rates of 11-48-0 per acre	
		25 lbs.	50 lbs.
		Increase in Yield Bushels per Acre	
Black and Black Transition (Central Alberta)	63	5.7	7.9
Dark Brown and Thin Black	86	6.9	9.3
Average for	149 tests	6.4	8.7

BROWN SOILS

The brown soils of Alberta lie in an area where moisture is the greatest limiting factor in crop production. Trials indicate that on the average under good management sufficient nutrients have become available each year under dry land conditions to supply the needs of most crops. However, on soils which have not been managed properly, fertilization may on the average prove beneficial. Experiments have indicated that on such soils some response may be obtained from the use of phosphorus fertilizers. This response has been most marked on soils which have been badly drifted. The greatest response occurs when moisture conditions are favourable.

Farmers in the area are urged to discuss their fertilizer problems with their nearest district agriculturist or experimental farm officials.

IRRIGATED SOILS OF SOUTHERN ALBERTA NEED ATTENTION

The fertility of intensively farmed irrigated soils of Southern Alberta cannot be maintained without a well-organized fertilizing program. Besides the addition of organic matter, such as barnyard manure or green manure, most irrigated soils respond to application of nitrogen and phosphorus. Applications of fairly high rates of ammonium nitrate (33.5-0-0), ammonium sulphate (21-0-0), or ammonium phosphate (16-20-0 or 11-48-0) have given good results for various crops.

Anhydrous ammonia (82-0-0) may be expected to give results similar to those obtained with other nitrogen fertilizers when equivalent amounts of nitrogen are applied. Because of the variety of specialty crops grown and the variation of fertilizer response from field to field, farmers in this area are urged to consult their local district agriculturist, field men, or experimental farm officials. Recommended rates of fertilizer application for a variety of irrigated crops may be found in Table 9, page 23.

This unfertilized drill width yielded 32.9 bushels per acre, while the fertilized strips on either side yielded 56.0 and 50.0 bushels respectively.

DOES IT PAY TO FERTILIZE?

GENERAL CONSIDERATIONS

There are many factors involved in the response obtained from fertilizers in Alberta. Year to year variations in local growing conditions, soil moisture, date of seeding, and time of harvesting are among the factors that must be considered.

From Table 5 you will note the wide difference in response to fertilizers obtained in a year of good moisture and in a year that was dry.

TABLE 5

The Yield of Wheat in Bushels on Soils Dept. Plots, University of Alberta — Edmonton.

Year	1947	1948	1949	1930-48
Moisture Conditions	Excellent	Good	Poor	Average
Yields per acre no fertilizer	44.5	42.2	9.2	35.7
Yields per acre fertilized	59.9	48.4	10.5	41.4
Increase per acre due to phosphate fertilizer	15.4	6.2	1.3	5.7

Because of this variation, using fertilizers on your farm for one year only may not tell the story. You should fertilize for at least three successive years, leaving a check strip unfertilized so that you can make your own comparisons. Only in this way can you assess the true value of the fertilizer used.

A casual visual inspection may not detect important yield increases resulting from fertilizer application. It is often difficult visually to detect a five bushel per acre difference in yield. Such an increase, resulting from fertilizer application, usually would bring a handsome profit.

Generally speaking, it has been profitable to fertilize grasses and grains at recommended rates throughout all soil zones except under dry land conditions in the brown soil zone. Because of a lack of moisture, fertilizing has not always been profitable in much of the brown soil zones.

There are frequently benefits besides yield increase from the use of phosphate fertilizers. These benefits are :

1. Earlier and more uniform maturity.
2. Improved feeding value of some crops.
3. A partial control of weeds resulting from better crop competition.

The extent to which these benefits are obtained vary depending on soil and moisture conditions as well as the area concerned. The earlier maturity usually resulting from phosphorus fertilization is especially valued by farmers in some areas.

SUMMERFALLOW

Good profits usually are obtained from use of recommended fertilizers on fallowed land. Table 4 gives the average yields for central and southern Alberta. An average increase of 8.7 bushels per acre was realized from an application of 50 pounds per acre of ammonium phosphate (11-48-0) at a cost of about $2.70.

Comparably profitable results have been obtained from fertilization of oats and barley grown on summerfallow.

Comparison of fertilizer costs with the increased yields obtained on grey and degraded black (transition) soils will show even greater profits. See, for example, Table 2, or obtain a copy of Bulletin No. 21, "Wooded Soils and Their Management", from the University of Alberta.

TABLE 6

Poundages of Fertilizers to Supply Various Quantities of Plant Nutrients.

To Supply Nitrogen (N)

Fertilizer	30 lbs. of N Approx. lbs. of fertilizer	40 lbs. of N Approx. lbs. of fertilizer	50 lbs. of N Approx. lbs. of fertilizer	60 lbs. of N Approx. lbs. of fertilizer
Anhydrous ammonia (82-0-0)	36	50	61	72
Ammonium nitrate (33.5-0-0)	90	120	150	180
Ammonium nitrate-phosphate (27-14-0)	111	145	189	222
Ammonium sulphate (21-0-0)	143	186	240	286

To Supply Phosphate (P_2O_5)

	10 lbs. of P_2O_5	20 lbs. of P_2O_5	30 lbs. of P_2O_5	40 lbs. of P_2O_5
Ammonium phosphate (11-48-0)	20	42	63	82
Complete (10-32-10)	31	63	98	126
Ammonium phosphate (16-20-0)	50	100	150	200

To Supply Potash (K_2O)

	10 lbs. of K_2O	20 lbs. of K_2O	30 lbs. of K_2O	40 lbs. of K_2O
Complete (10-32-10)	100	200	300	400
Potassium chloride (0-0-60)	16	33	50	66
Potassium sulphate (0-0-51)	20	40	60	80

FERTILIZERS FOR STUBBLE CROPS AND STRAW DECOMPOSITION

The generally lower yields of crops grown on stubble land as compared with those grown after fallow is widely recognized. During a summerfallow year nitrogen available to crops accumulates in the soil due to decomposition of soil humus and organic matter. The available supply of some other essential plant nutrients also is increased when land is fallowed. These

extra available nutrients, the control of weeds and the small amount of moisture saved by fallowing are responsible for the better yields on such land.

Stubbled-in crops must get along with only the nutrients which become available as the crop is growing. If the land in question is in a good state of fertility and has been producing good crops then ammonium phosphate 16-20-0 or 11-48-0 generally will give profitable yield increases as shown in Tables 3 and 7.

If humus and organic matter in the stubble land are not decomposing at a rapid rate, crops may be nitrogen deficient and poorer yields may result. This usually occurs when there is heavy combine straw on land that has been cropped for many years. Insufficient readily available nitrogen will result in a pale yellow-green poor yielding crop.

TABLE 7

Yield increases in bushels per acre resulting from fertilization of grain crops grown on stubble. Central Alberta — 1946 - 1955.

Crop	No. of Tests	Yield without Fertilizer	Kind of Fertilizer		
			11-48-0 lb. per acre		16-20-0 lb. per acre
			25	50	60
			Bushels of Increase		
Wheat	13	19.2	2.7	5.1	4.3
Oats	8	40.0	8.1	9.5	8.5
Barley	41	27.1	4.3	8.5	7.5

Various nitrogen fertilizers have been tried on stubble fieilds in many parts of Alberta in recent years and the following findings have resulted:

1. Although results have been highly variable even in the same district, between 1/3 and 1/2 of the fields tested have given profitable yield increases from the use of nitrogen fertilizers.

2. Where nitrogen fertilizers are used the recommended application of phosphate should be applied at seeding time. (See Table 9).

3. Nitrogen fertilizers may be applied in the fall or in the spring. No difference in effectiveness as yet has been found in Alberta.

4. Three nitrogen fertilizers are currently available in Alberta; anhydrous ammonia, ammonium nitrate and ammonium sulphate. Tests to date have shown no difference in the effectiveness of the nitrogen in these three forms. However, sulphur in ammonium sulphate will be beneficial on sulphur deficient grey soils where legumes are to be grown.

5. In general, the fields showing the greatest response to nitrogen fertilization are those which have been cropped for many years and are now showing a definite drop in productivity.

6. The most economical rates of nitrogen fertilization have not been accurately determined as yet, and it is suggested that anyone suspecting nitrogen starvation of crops grown on stubble land should put down test strips using rates varying from 20 to 60 pounds per acre of actual nitrogen. See Table 6, page 18, for rate of the various nitrogen fertilizers to give the required poundage of nitrogen.

FERTILIZER PRACTICES

METHODS OF APLICATION

There are several methods of applying fertilizer, each of which has its advantages. The method to be used depends on the crops, soil, climate, date and rate of application, kind of fertilizer, and equipment available. The aim should be to get the fertilizer into the soil where it will do the most good.

Several types of fertilizer machinery are now on the market. Combination fertilizer-seed drills and attachments that can be used with several different seed drills are available. The attachments are the most common. Broadcast spreaders and specially-designed side-dressing applicators for row crops also are being used on Alberta farms and ranches. Special equipment is used for the application of anhydrous ammonia. (See page 11.)

A worn-out grain drill may be used to apply the recommended amounts of fertilizer to hay crops and stubble fields. Fertilizer will very rapidly corrode and wear the parts of any drill. Do not use a machine which is still useful for seeding grain.

Usually it will be necessary to broadcast ammonium nitrate and ammonium sulphate when they are applied at rates of 40 or more pounds per acre of nitrogen. There are two reasons for this. Firstly, it is seldom possible to get equipment which can apply these poundages while seeding grain at the same time. Secondly, if large amounts of nitrogen fertilizer are

TABLE 8.

Average yield increases in bushels per acre resulting from nitrogen fertilization of grains grown in fields having combine straw. Central Alberta (Clyde to Carstairs), 1949 - 1955.

Crop.	Yield without fertilizer.	No. of tests.	Pounds per acre of nitrogen applied.			
			33		67	
			Bus. of increase.	No. of tests.	Bus. of increase.	No. of tests.
Wheat	27.6	14	4.2	11	12.7	9
Oats	42.2	17	11.4	10	18.9	7
Barley	32.5	42	5.7	34	9.5	16

NOTE :—Twenty of the above tests were conducted in 1955 and in those tests the normal phosphate application of 50 lbs. per acre of 11-48-0 was made at seeding time to one-half of each area fertilized with nitrogen. In 19 of the 20 tests the phosphate application increased yield, the average increase for all grains on all farms being 290 pounds of grain per acre.

placed in the ground touching the seed, germination may be adversely affected. Nitrogen fertilizers may be applied, broadcast in the fall or in the spring either as a separate operation or when carrying out an ordinary tillage operation. These fertilizers are highly soluble and will wash into the soil with the first rain. However, in Alberta they probably will not leach down in the soil beyond the reach of crop roots.

Commercial fertilizers have been tested on a variety of crops throughout Alberta for many years, and on this basis the following recommendations are outlined:

CEREAL CROPS

Grain crops do best when fertilizers are drilled in with the seed. This places the fertilizer where the young plants can use it readily. Use a fertilizer attachment on your grain drill or a combination fertilizer-grain drill. Do not mix fertilizer with the grain in the ordinary seed drill, because the rate of seeding and fertilizer application are likely to be uneven. Moreover, this method of fertilizer application usually causes excessive corrosion and wear in the drill. Recommended rates of fertilizer application will be found in Table 9, page 23.

GRASSES AND LEGUMES

Forage crops are assuming a role of increasing importance in Alberta agriculture. Accordingly, more tests to determine fertilizer needs of these crops have been conducted in recent years. In general, profits from fertilization of forage crops compare favorably with profits from fertilizer use on grain. Results from hay fertilization are profitable especially when legumes growing on sulphur-deficient grey soil are fertilized. (See Table 2, page 13.)

Recommendations for fertilization of hays vary with soil zones, soil textures, and kind of hay. In the dark brown and black soil zones, grass hays generally respond to nitrogen or to nitrogen and phosphorus. In these areas phosphorus is the most important need of legumes. On sandy soils legumes may also respond to nitrogen although this may be due to poor inoculation of the legume. In the black and dark brown soil zones the need for nitrogen as well as phosphorus when fertilizing grass-legume mixtures will depend on the proportions of the two kinds of plants. On sandy soils or when the proportion of grass is high, nitrogen as well as phosphorus usually will be needed. On the sulphur-deficient grey soils west and north of the central Alberta black soil zone legumes and legume-grass mixtures respond primarly to sulphur and phosphorus. Peats are highly variable. On them a fertilizer supplying nitrogen and phosphorus such as 16-20-0, or a complete fertilizer usually will give best results.

Any of the equipment described in the section "Methods of Application" (page 20) may be used to fertilize hays. Nitrogen fertilizer may be applied in the late fall or early spring when hay is the crop to be harvested. If grass is being grown for seed production, nitrogen fertilization immediately after seed harvest is recommended. Best results from phosphate fertilization usually are obtained when applications are made very early in the spring. Sulphur fertilization of legumes may be done at any convenient time. On established stands of alfalfa in irrigated areas of Alberta, broadcasting of fertilizer is recommended because of the danger of spreading bacterial wilt with the furrow openers on a standard drill.

Yield increase is not the only benefit from forage crop fertilization. The protein content and the general nutritive value of hay often are improved. In addition, phosphate fertilization frequently will help maintain the legume in a grass-legume mixture.

Do not mix inoculated legume seed with fertilizer. The fertilizer may harm the nitrogen fixing bacteria, and fertilizer sticking to the moist seed may lower germination.

Recommendations for fertilization of forage crops are given in Table 9, page 23.

FRESHLY BROKEN SOD

When brome grass, creeping red fescue and some other fibrous sods are broken up special fertilizer practices are often needed. Soils in such fields usually are low in their supply of available nitrogen and additional nitrogen is often needed to promote decomposition of the root fibre. When this type of sod is broken after early July nitrogen fertilization is likely to be beneficial if the land is to be cropped the following year.

Because of an inadequate number of field tests specific recommendations can not be made as yet. Those wishing to test a nitrogen fertilizer in such a case are advised to use 30 to 60 pounds per acre of nitrogen on a part of the field. This application of nitrogen may be made after breaking or in early spring. The recommended application of phosphorus fertilizer should be made at seeding time.

SUGAR BEETS

Profitable sugar beet production depends on adequate fertilization. Application of ammonium phosphate fertilizer at the time of seeding has become standard practice with growers. Where soil fertility is low, additional nitrogen may be needed, and this may be applied prior to seeding during land preparation or as a side dressing immediately after thinning. Recommended rates of application may be found in Table 9, page 23.

POTATOES

Fertilizer trials on potato crops have not been extensive, but from those conducted promising results have been obtained.

Application of ammonium phosphate fertilizer at planting time, placed in bands slightly below and to the side of the seed pieces, has given good results. Recommended rate of application may be found in Table 9, page 23.

GARDEN AND CANNING CROPS

When fertilizing crops such as corn, peas, beets and beans, drill the fertilizer near the seed row on each side. Do not mix garden seeds directly with fertilizer, as this often will retard germination or even kill the young plant. Where fertility is low, a pre-seeding application of fertilizer and barnyard manure worked into the soil is highly desirable. Recommended rate of application may be found in Table 9, page 23.

TABLE 9

Recommended Rates of Fertilizer Application for Alberta Crops

(Pounds per Acre)

	Grains	Flax	Grasses		Legumes and Mixtures Forage	Legumes Seed	Peas and Beans	Corn	Sugar Beets	Potatoes
			Forage	Seed						
Dark Brown and Thin Black Soil Zones										
A.P. 11-48-0	40	30	—	—	—	—	—	—	—	100–200
A.P. 16-20-0	60	30	100–200	100–200	—	—	—	—	—	—
A.N. 33.5-0-0	—	—	100–200	150–300	—	—	—	—	—	—
A.S 21-0-0	—	—	150–300	150–300	—	—	—	—	—	—
Black and Degraded Black (Transition) Soil Zone										
A.P. 11-48-0	50	25	50–100	—	50–150	—	30–50	50 100	—	100–250
A.P. 16-20-0	75	40	100–200	150–200	100–200	—	60–100	50–100	—	100 250
A.N. 33.5-0-0	—	—	100–200	100–200	—	—	—	—	—	—
A.S 21-0-0	—	—	150–300	150–300	—	—	—	—	—	—
Grey Soil Area West and North of Main Black Soil Area										
A.P. 16-20-0	70	40	50–150	150–200	50–150	50–60	60–100	—	—	100–250
A.S. 21-0-0	60	40	50 150	150–300	50–150	30 50	60–100	—	—	100–250
A.N. 33.5-0-0	—	—	—	100–200	—	—	—	—	—	—
Sodium Sulpate and Gypsum	—	—	—	—	50–150	40–60	—	—	—	—
Sulphur	—	—	—	—	20–50	8–10	—	—	—	—
Peace River Region Grey Soils (See above for Black Soils)										
A.P. 11-48-0	25–50	25–50	—	—	—	—	—	—	—	100–200
A.P. 16-20-0	60–120	—	150–200	150-200	—	—	—	—	—	—
A.N. 33.5-0-0	—	—	75-100	75–100	—	—	—	—	—	—
Irrigated Lands										
A.P. 11-48-0	—	—	—	—	100	—	50	—	100	150
A.P. 16-20-0	100–150	—	125	—	100	—	—	150	—	—
A.N. 33.5-0-0	—	—	100	—	—	—	—	—	200 (1)	—
A.S 21-0-0	—	—	150	—	—	—	—	—	300	—

(1) Side dressed or as a pre-seeding application.

THE ALBERTA ADVISORY FERTILIZER COMMITTEE

The Alberta Advisory Fertilizer Committee supervises test work each year, and its recommendations provide a consensus of authoritative opinions of specialists in this field.

Much of the earlier test work supervised by the Committee was with wheat on summerfallowed land in the dark brown, thin black and black soil zones. However in recent years tests on all grain crops on stubble and fallowed land have been conducted and all soil zones are receiving attention. Tests are also being made on forage crops grown for hay and seed production. It is important to realize that a large number of tests over a large area and over a number of years are needed before sound recommendations for fertilizer use can be made. The Committee is endeavoring to have tests carried out in all parts of the province using fertilizers on the market. New fertilizers appearing on the market receive the Committee's close attention and are included in the tests conducted.

Results of the tests indicate that best use is not being made of fertilizers. Many farmers not using fertilizers would obtain profitable yield increases by their use.

The duties of the Alberta Advisory Fertilizer Committee are:

1. To co-ordinate and guide in so far as is possible fertilizer investigations and testing in Alberta.
2. To assemble and examine experimental data from the testing of fertilizers in Alberta.
3. To make recommendations for the use of fertilizers in Alberta.
4. To publicize recommendations of the Committee with a view to encouraging good soil management practices.
5. To safeguard the interests of agriculture by arranging for the testing of fertilizers under practical farm conditions so that recommendations of the Committee will be supported by practical experimental data.

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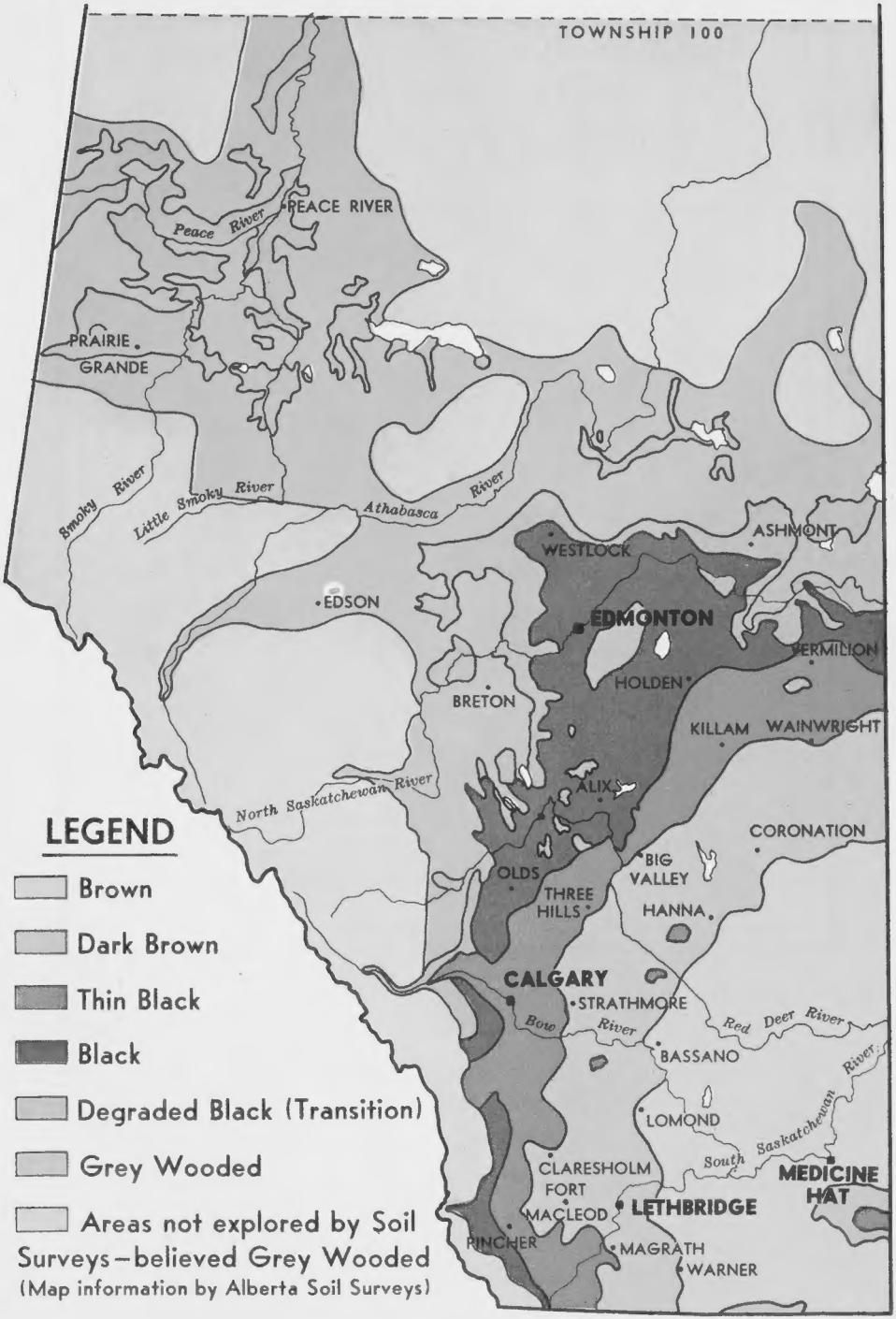
SOIL ZONES OF ALBERTA



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